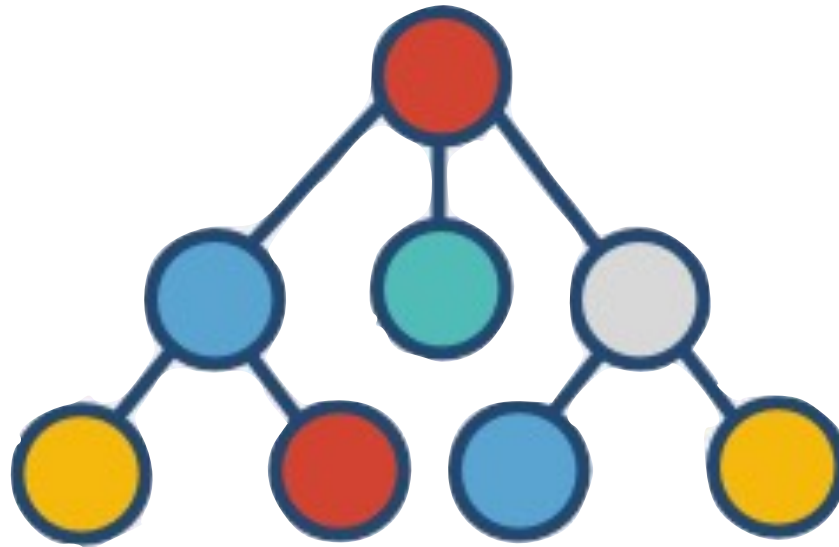


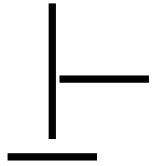
# DATA STRUCTURE & ALGORITHMS



**(By Prince Agarwal)**  
**[ “HELLO WORLD” ]**

## TYPES OF BINARY TREE IN C++

### ■ TYPES OF BINARY TREE ?

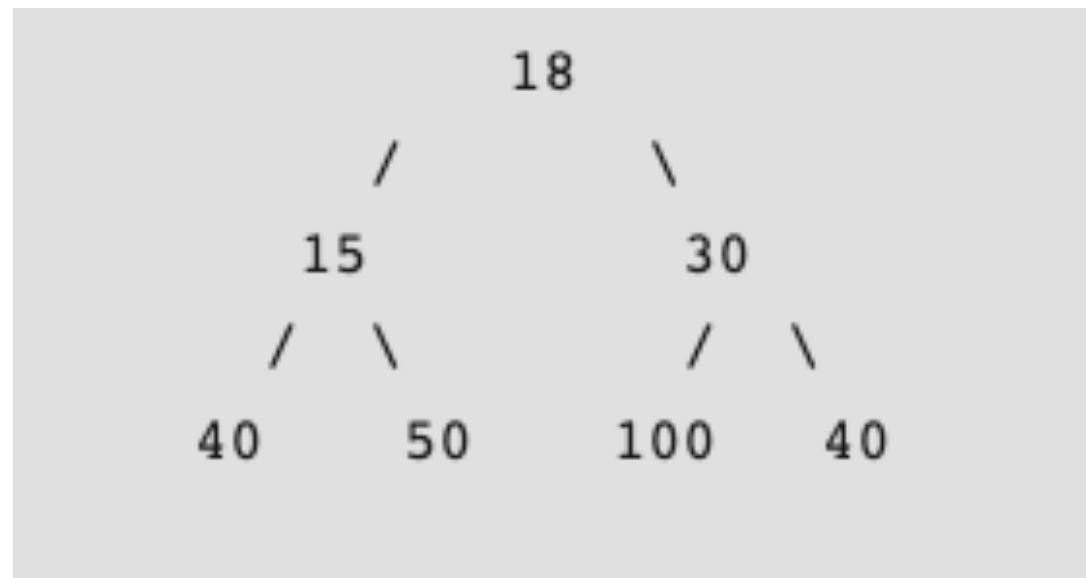


#### ■ Full Binary Tree

A Binary Tree is a full binary tree if every node has 0 or 2 children

Or

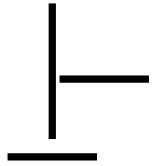
A full binary tree is a binary tree in which all nodes except leaf nodes have two children.



Hello world

## TYPES OF BINARY TREE IN C++

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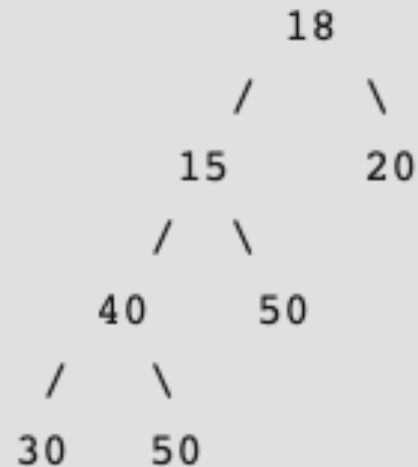


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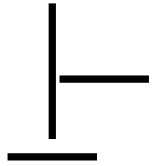
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Hello world

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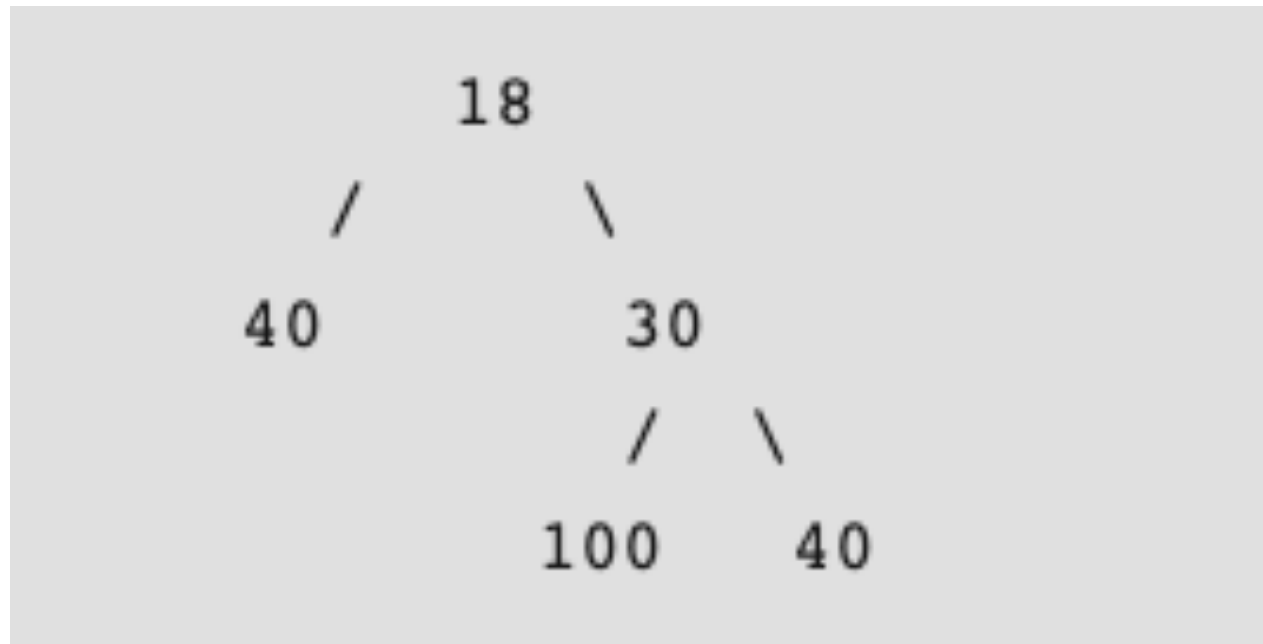


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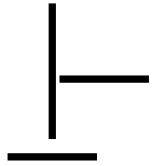
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Hello world

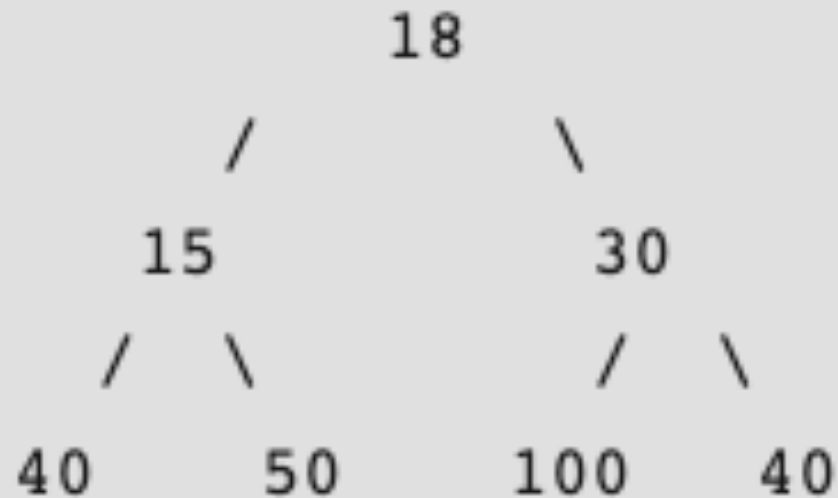
## TYPES OF BINARY TREE IN C++

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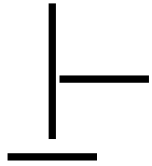
#### ■ Complete Binary Tree

A Binary Tree is a complete Binary Tree if all the levels are completely filled except possibly the last level and the last level has all keys as left as possible



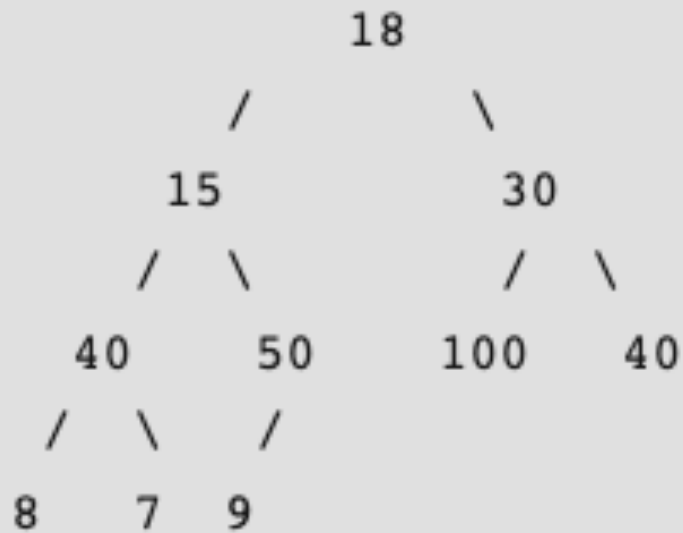
## TYPES OF BINARY TREE IN C++

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Hello world

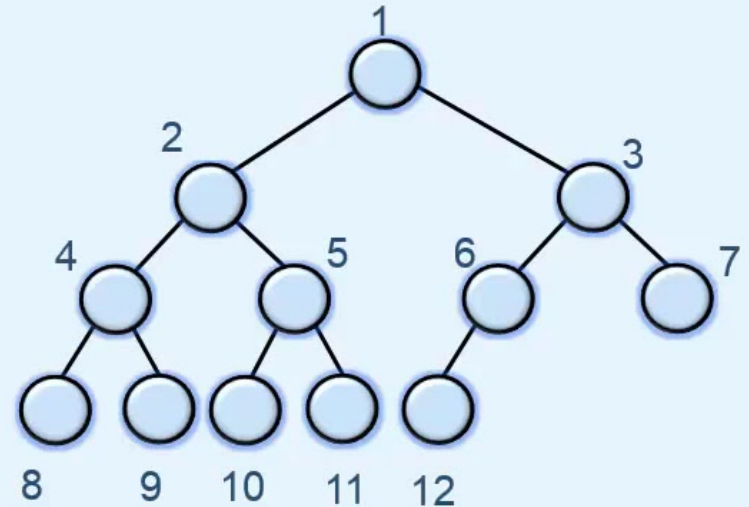
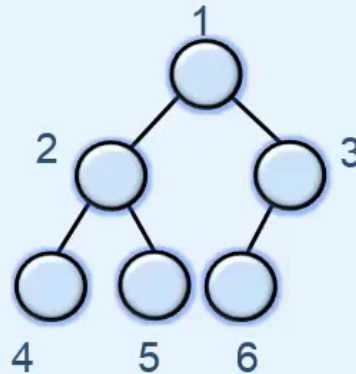
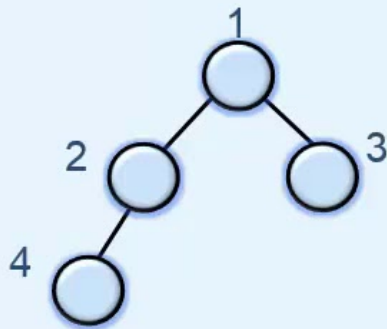
## TYPES OF BINARY TREE IN C++

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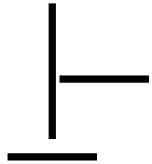
A Binary Tree is a complete Binary Tree if all the levels are completely filled except possibly the last level and the last level has all keys as left as possible

### Complete Binary Tree



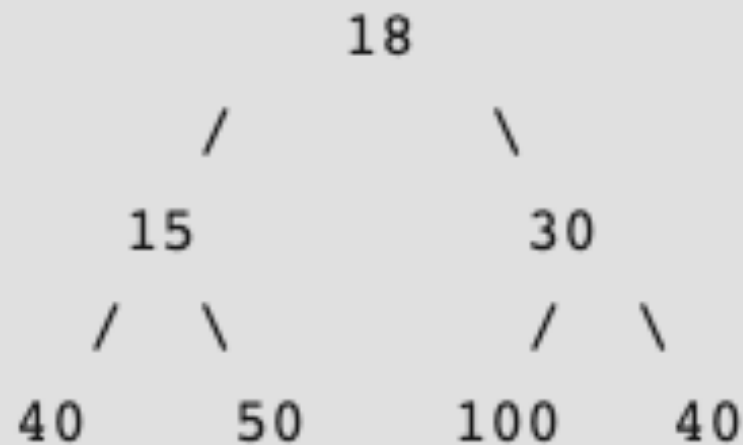
## TYPES OF BINARY TREE IN C++

### ■ TYPES OF BINARY TREE ?



#### ■ Perfect Binary Tree

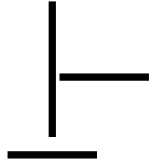
A Binary tree is a Perfect Binary Tree in which all the internal nodes have two children and all leaf nodes are at the same level





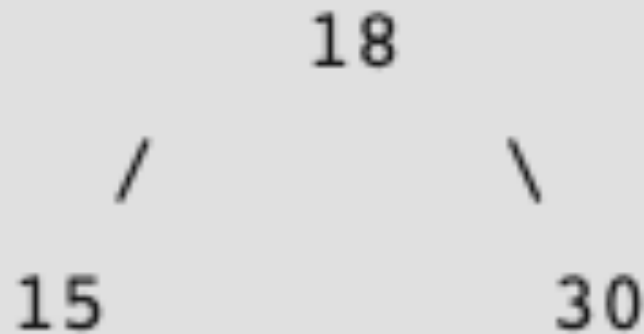
## TYPES OF BINARY TREE IN C++

### ■ TYPES OF BINARY TREE ?



#### ■ Perfect Binary Tree

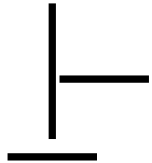
A Binary tree is a Perfect Binary Tree in which all the internal nodes have two children and all leaf nodes are at the same level



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## TYPES OF BINARY TREE IN C++

### Types of Binary Tree ?



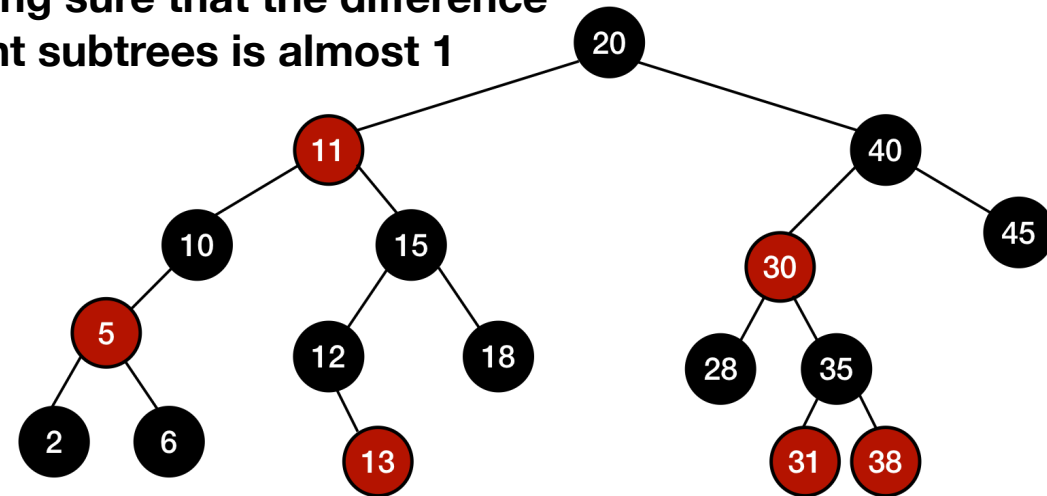
#### Balanced Binary Tree

A binary tree is balanced if the height of the tree is  $O(\log n)$  where  $n$  is the number of nodes.

Example,

**AVL tree** maintains  $O(\log n)$  height by making sure that the difference between the heights of the left and right subtrees is almost 1

**Red-Black** trees maintain  $O(\log n)$  height



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## TYPES OF BINARY TREE IN C++

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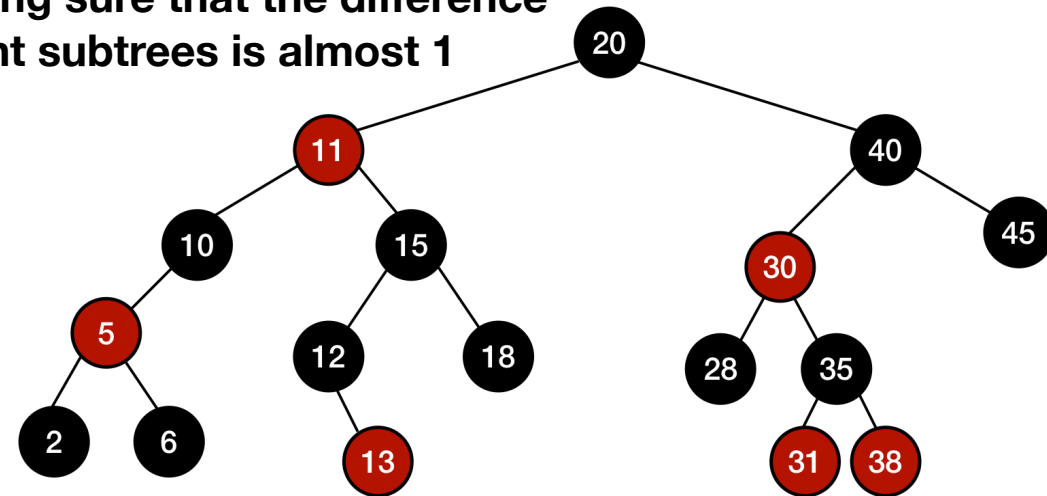
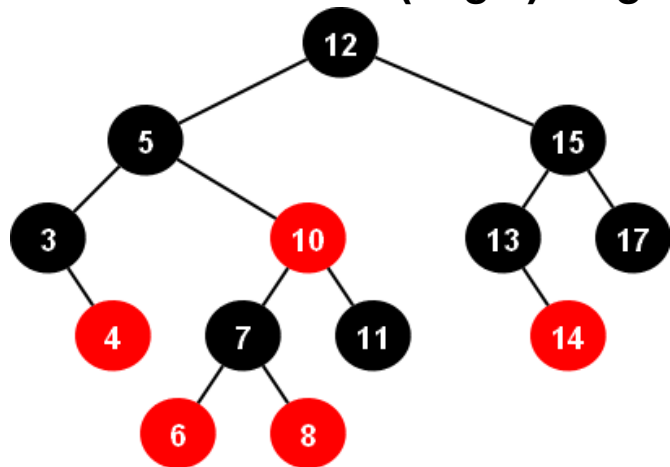


A binary tree is balanced if the height of the tree is  $O(\log n)$  where  $n$  is the number of nodes.

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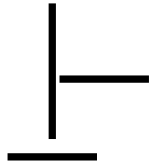
**Red-Black** trees maintain  $O(\log n)$  height



Hello world

## TYPES OF BINARY TREE IN C++

### ■ TYPES OF BINARY TREE ?



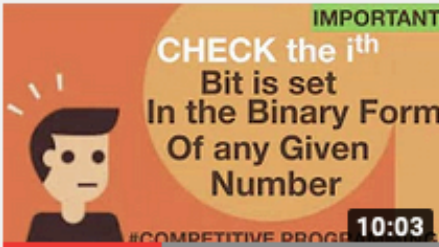




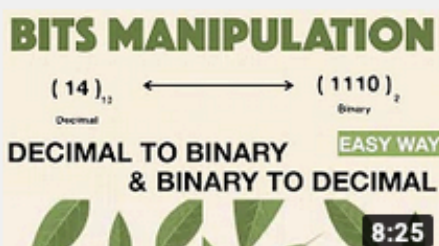
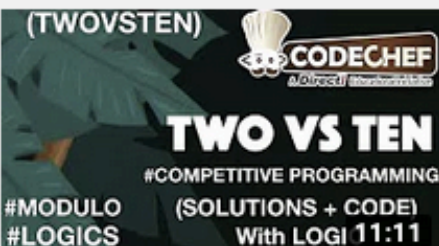








#### ■ A degenerate (or pathological) Binary Tree

A Tree where every internal node has one child.

```
10
 /
20
 \
30
 \
40
```

Such trees are performance-wise same as linked list.

Hello world

 <p><b>CHECK the <math>i^{\text{th}}</math> Bit is set In the Binary Form Of any Given Number</b></p> <p>IMPORTANT</p> <p>#COMPETITIVE PROGRAMMING 10:03</p>	 <p><b>COUNT THE NUMBER OF ONE'S PRESENT IN BINARY NUMBER</b></p> <p>VERY EASY</p> <p>#COMPETITIVE PROGRAMMING 13:44</p>	 <p><b>CHECK GIVEN NUMBER IS POWER OF 2 ?</b></p> <p>EASY WAY</p> <p>(FULL EXPLANATION WITH CODE)</p> <p>#BITWISE #BINARY</p> <p>HW Hello World</p> <p>#COMPETITIVE PROGRAMMING 15:28</p>	 <p><b>LEFT SHIFT RIGHT SHIFT BITWISE OPERATOR</b></p> <p>EASY WAY</p> <p>(PART - 02)</p> <p>#COMPETITIVE PROGRAMMING 15:24</p>	 <p><b>AND NOT XOR OR BITWISE OPERATOR</b></p> <p>EASY WAY</p> <p>(PART - 01)</p> <p>#COMPETITIVE PROGRAMMING 13:06</p>
<p>Check the <math>i^{\text{th}}</math> bit is set, in the binary form of given number...</p> <p>1.1K views • 1 year ago</p>	<p>Count the number of one's in binary representation of...</p> <p>1.6K views • 1 year ago</p>	<p>Check a given number is power of 2   Bitwise operator...</p> <p>3.2K views • 1 year ago</p>	<p>Left shift and right shift bitwise operator   ...</p> <p>1.4K views • 1 year ago</p>	<p>Bitwise Operators   AND   NOT   OR   XOR    Competitive...</p> <p>1.8K views • 1 year ago</p>
 <p><b>BITS MANIPULATION</b></p> <p>(14)<sub>10</sub> ↔ (1110)<sub>2</sub></p> <p>Decimal Binary</p> <p><b>DECIMAL TO BINARY &amp; BINARY TO DECIMAL</b></p> <p>EASY WAY</p> <p>#8:25</p>	 <p>(TWOVSTEN)</p> <p><b>TWO VS TEN</b></p> <p>#COMPETITIVE PROGRAMMING</p> <p>#MODULO #LOGICS</p> <p>(SOLUTIONS + CODE) With LOGI 11:11</p>	 <p>(CHEFROUT)</p> <p><b>CHEF AND HIS DAILY ROUTINE</b></p> <p>#COMPETITIVE PROGRAMMING</p> <p>(SOLUTIONS + CODE) With LOGI 12:56</p>	 <p><b>EUCLIDEAN ALGORITHM</b></p> <p>FINDING GCD OF TWO NUMBERS</p> <p>#COMPETITIVE PROGRAMMING</p> <p>12:31</p>	 <p><b>SEIVE OF ERATOSTHENES</b></p> <p>PART - 02 (CODE)</p> <p>#COMPETITIVE PROGRAMMING 12:01</p>
<p>Bits Manipulation   Decimal to Binary   Binary to Decimal...</p> <p>1.5K views • 1 year ago</p>	<p>Program of Two vs Ten Codechef - TWOVSTEN   ...</p> <p>1.3K views • 1 year ago</p>	<p>Program of chef and his daily routine - CHEFROUT   ...</p> <p>1.7K views • 1 year ago</p>	<p>Euclidean algorithm for finding GCD of 2 numbers   ...</p> <p>2K views • 1 year ago</p>	<p>Sieve of Eratosthenes -part 2    Competitive programming...</p> <p>2.2K views • 1 year ago</p>
 <p><b>SEIVE OF ERATOSTHENES</b></p> <p>PART - 01 (LOGIC)</p> <p>#COMPETITIVE PROGRAMMING 8:38</p>	 <p>#Concept / Program of #Prime Numbers</p> <p><b>CONCEPT OF PRIME NUMBERS</b></p> <p>#COMPETITIVE PROGRAMMING 13:38</p>	 <p>VERY IMPORTANT CONCEPTS</p> <p>#memset() function #In C/C++</p> <p><b>USE OF MEMSET()</b></p> <p>#COMPETITIVE PROGRAMMING 12:00</p>	 <p>(FANCY)</p> <p><b>FANCY QUOTES</b></p> <p>#COMPETITIVE PROGRAMMING (SOLUTIONS + CODE) With LOGI 15:46</p> <p>#Strings #getline()</p>	 <p>(ALPHABET)</p> <p>#Clears String Concept #String</p> <p><b>STUDYING ALPHABET</b></p> <p>#COMPETITIVE PROGRAMMING (SOLUTIONS + CODE) With LOGIC 24:28</p>
<p>Sieve of Eratosthenes -part 1    Competitive programming...</p> <p>3.4K views • 1 year ago</p>	<p>Program and concept of prime numbers.   ...</p> <p>2.1K views • 1 year ago</p>	<p>memset() function in C/C++ and its syntax.    Competitive...</p> <p>4.3K views • 1 year ago</p>	<p>problem of Fancy Quotes    getline() in strings --FANCY...</p> <p>2.1K views • 1 year ago</p>	<p>Concept of Handling the String related problems -...</p> <p>3.4K views • 1 year ago</p>

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